One example of a *weighted average* in sports is a batter's *slugging average* (or *percentage*) in baseball. The slugging average (***SLG***) is calculated using the following equation:

$$SLG = \frac{(1 \cdot S) + (2 \cdot D) + (3 \cdot T) + (4 \cdot HR)}{AB}$$

where S = singles, D = doubles, T = triples, HR = home runs, and AB = total at-bats.

Each single has a weight of 1, each double a weight of 2, each triple a weight of 3, and each home run a weight of 4. An at-bat without a hit has a weight of 0.

In his first season with the New York Yankees, Babe Ruth set a record for slugging average that stood for more than 80 years. In 1920, Ruth pounded 172 hits in 458 at-bats. His hits consisted of 73 singles, 36 doubles, 9 triples, and 54 home runs, resulting in a total base count of $(73 \cdot 1) + (36 \cdot 2) + (9 \cdot 3) + (54 \cdot 4) = 388$. When his total number of bases (388) is divided by his total at-bats (458), the result is .847, his slugging percentage for the season. This record was broken in 2001 by Barry Bonds, who had 411 total bases in 476 at-bats for a slugging average of .863. (Statistics from www.baseball-almanac.com)

$$SLG = \frac{(1 \cdot S) + (2 \cdot D) + (3 \cdot T) + (4 \cdot HR)}{AB}$$

1. Find the slugging average for a player with the following statistics:

$S = 68$
$D = 40$
$T = 4$
$HR = 16$
$AB = 320$

$$\frac{(1 \cdot 68) + (2 \cdot 40) + (3 \cdot 4) + (4 \cdot 16)}{320}$$

$$\frac{68 + 80 + 12 + 64}{320} = \frac{224}{320}$$ .7

The National Football League (NFL) rates quarterbacks for statistical purposes against a fixed performance standard based on the statistical achievements of all qualified pro passers since 1960. This system allows passing performances to be compared from one season to the next.

The following categories are used to compute the quarterback rating:

- percent of completions per attempt (***%COMP***)
- percent of touchdown passes per attempt (***%TD***)
- percent of interceptions per attempt (***%INT***)
- average yards gained per attempt (***YD***)

(From www.nfl.com/help/quarterbackratingformula)

The following is the formula for compiling the quarterback rating (***QR***):

$$QR = \frac{25 + 10(\%COMP) + 40(\%TD) - 50(\%INT) + 50(YD)}{12}$$

(***Note***: This formula is subject to a few conditions discussed after Question 2.)

$$QR = \frac{25 + 10(\%COMP) + 40(\%TD) - 50(\%INT) + 50(YD)}{12}$$

1. For the first two games of the 2008 season, Dallas Cowboys quarterback Tony Romo completed 45 passes in 62 attempts for a total of 632 yards, with 4 touchdowns and 2 interceptions. Verify that Romo's quarterback rating for those games is approximately 113. Round each value to the nearest tenth.

Percent of completions per attempt (*%COMP*) = $\frac{45}{62} = 72.6 \times 10 = 726$

Percent of touchdown passes per attempt (*%TD*) = $\frac{4}{62} = 6.5 \times 40 = 258$

Percent of interceptions per attempt (*%INT*) = $\frac{2}{62} = 3.2 \times 50 = 161$

Average yards gained per attempt (*YD*) = $\frac{632}{62} = 10.2 \times 50 = 510$

$$QR = \frac{25 + 726 + 258 - 161 + 510}{12} = \frac{1.358}{12} = 113$$

An *index* is a numerical scale. Characteristics of an index can be used for the following:

- to compare variables with one another or a reference number,
- to give information about general trends, and
- to help make comparisons and judgments.

It is often calculated as a weighted sum of various factors resulting in a single summary number.

The Fan Cost Index (FCI), compiled by Team Marketing Report, tracks the cost for a family of four to attend a professional sporting event. The FCI includes the prices of 2 average-price adult tickets, 2 average-price child tickets, 4 small soft drinks, 2 small other drinks, 4 regular-size hot dogs, parking for 1 car, 2 game programs, and 2 least expensive, adult-size adjustable caps. The Average Ticket Price in the following tables represents the average cost of a ticket for each member of the family.

The FCI for each Texas team in professional baseball, basketball, and football for 2006 and 2007 is shown in the following two tables. The Soft Drink column includes the price of 1 drink and its size in ounces.

2006 Fan Cost Index

Team	Avg. Ticket Price	Soft Drink (size in oz)	Other Drink	Hot Dog	Parking	Program	Cap	FCI
Rangers	15.81	2.75 (16)	6.00	2.50	8.00	5.00	10.00	134.24
Astros	26.66	4.00 (21)	7.00	4.00	10.00	4.00	11.00	192.64
Spurs	45.88	3.75 (24)	6.25	4.00	10.00	5.00	18.00	283.02
Mavericks	54.24	2.75 (12)	4.00	4.00	20.00	6.00	15.00	313.96
Rockets	38.64	4.00 (22)	5.75	4.25	15.00	—	20.00	254.06
Cowboys	66.12	3.50 (32)	5.00	3.50	12.00	5.00	10.00	344.48
Texans	56.97	3.25 (21)	6.00	5.00	15.00	5.00	20.00	337.88

(Compiled from www.teammarketing.com)

2007 Fan Cost Index

Team	Avg. Ticket Price	Soft Drink (size in oz)	Other Drink	Hot Dog	Parking	Program	Cap	FCI
Rangers	16.47	3.00 (20)	6.50	2.75	8.00	5.00	11.00	141.88
Astros	26.90	4.00 (21)	7.00	4.25	10.00	4.00	12.00	196.60
Spurs	51.24	2.50 (24)	6.00	4.00	10.00	6.00	21.00	306.96
Mavericks	60.58	2.75 (15)	4.00	4.00	20.00	6.00	15.00	339.32
Rockets	41.98	4.00 (22)	7.00	4.50	15.00	—	20.00	270.92
Cowboys	84.12	3.50 (32)	5.00	3.50	12.00	5.00	10.00	416.48
Texans	62.41	3.25 (21)	6.00	5.00	15.00	5.00	20.00	359.64

(Compiled from www.teammarketing.com)

2. There are seven components in the FCI. Find the largest percent increase in a single component from 2006 to 2007 by giving the team, component, and percent increase.

06 FCI	07 FCI	
134.24	141.88	6%
192.64	196.60	2%
283.02	306.96	8%
313.96	339.32	8%
254.06	270.92	7%
344.48	416.48	21% *
337.88	359.64	6%

$$\frac{134.24}{134.24}x = \frac{141.88}{134.24} = 1.06$$

6%

Dallas Cowboys Ticket price by 27%